CS240 – Craps Discussion Sheet NAMES:

We are going to figure out the probability of winning the casino game **craps**. Craps involves throwing two dice at the same time and examining their sum. Certain sums win, certain sums lose, and certain sums cause you to throw the dice again.

Here are the rules:

- An initial throw whose sum is 7 or 11 wins immediately.
- An initial throw whose sum is 2, 3, or 12 loses immediately.
- For any other throw, the sum becomes the player's "point." The player then continues throwing the pair of dice repeatedly until either (1) the point comes up again, in which case the player wins, or (2) a sum of 7 comes up, in which case the player loses. *Note that for the point to come up again, all that matters is that the sum of the dice add up to the point, not that the values of the individual dice are the same as in the initial throw. In essence, for this game, we never care about the individual values, only their sum.*

For this activity, you must compute the probability of winning a single game of craps. Here is a suggested set of steps you take:

- Make a table that shows, for a single throw of two dice, the probability of each possible sum coming up.
- Determine the probability of winning on the initial throw (an **immediate win**).
- Determine the probability of a **delayed win**, which is the probability that two things happen: (1) your initial roll is something besides 7, 11, 2, 3, or 12, **and** (2) you roll that same sum again (your point) before you roll a 7. *Note: while there are six possible values for points (4, 5, 6, 8, 9, 10), you really only have to analyze three situations*.
    - Let's call your point T. The hard part is determining the probability of rolling a T again before rolling a 7. One way to look at this is to consider the individual probabilities of winning on each roll after you roll your point. In other words, if we call the first roll after your point roll "Roll 1," then the probability of rolling a T before rolling a 7 is:
        - the probability of rolling a T on Roll 1, plus
        - the probability of not rolling a T or a 7 on Roll 1 and rolling a T on Roll 2, plus
        - the probability of not rolling a T or a 7 on Rolls 1 and 2, and rolling a T on Roll 3, plus…
    - You can solve this infinite sum (it will be a geometric series).
- The probability of winning is then the probability of an immediate win plus the probability of a delayed win.